



US009463926B2

(12) **United States Patent**
Guering

(10) **Patent No.:** **US 9,463,926 B2**
(45) **Date of Patent:** **Oct. 11, 2016**

(54) **AUTOMATED STORAGE CABINET FOR
TROLLEYS, AND AIRCRAFT
INCORPORATING SUCH A CABINET**

USPC 414/280
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,074,496 A 12/1991 Rezag et al.
6,152,287 A * 11/2000 Luria 198/465.1
6,663,043 B1 12/2003 Luria

(Continued)

FOREIGN PATENT DOCUMENTS

CN 101353106 A 1/2009
DE 102 04 892 8/2003

(Continued)

OTHER PUBLICATIONS

International Search Report for Application No. PCT/FR2011/
000471 dated Feb. 3, 2012. Chinese Office Action for Application
No. 201180040605.8 dated Nov. 21, 2014.

(Continued)

Primary Examiner — Jonathan Snelting

(74) *Attorney, Agent, or Firm* — Jenkins, Wilson, Taylor
& Hunt, P.A.

(57)

ABSTRACT

The present invention relates to an automated storage cabinet for trolleys. It includes a device for automatically handling a single trolley with a handling basket including a vertical plate perpendicular to the waiting area, vertically movable between the floor of the waiting area and any one of the levels of the trolley storage cabinet, and two side flanks, connected to the vertical plate and provided with structure for supporting, on either side, two opposite sides of a trolley in the waiting area and for transferring the supported trolley through an opening of the predetermined compartment. The handling device can include structure for inserting the trolley into or extracting the trolley from the predetermined compartment.

11 Claims, 7 Drawing Sheets

(71) Applicant: **Airbus Operations (SAS)**, Toulouse
(FR)

(72) Inventor: **Bernard Guering**, Montrabe (FR)

(73) Assignee: **Airbus Operations (S.A.S.)**, Toulouse
(FR)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 461 days.

(21) Appl. No.: **13/772,726**

(22) Filed: **Feb. 21, 2013**

(65) **Prior Publication Data**

US 2013/0259612 A1 Oct. 3, 2013

Related U.S. Application Data

(63) Continuation of application No.
PCT/FR2011/000471, filed on Aug. 23, 2011.

(30) **Foreign Application Priority Data**

Aug. 24, 2010 (FR) 10 56733

(51) **Int. Cl.**

B65G 1/06 (2006.01)

B64D 9/00 (2006.01)

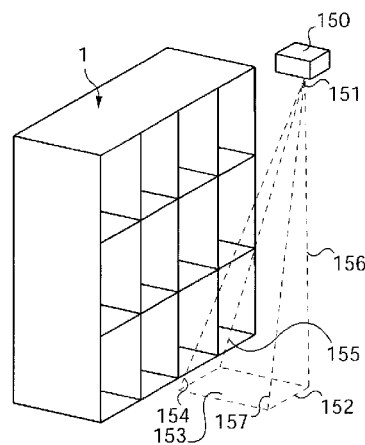
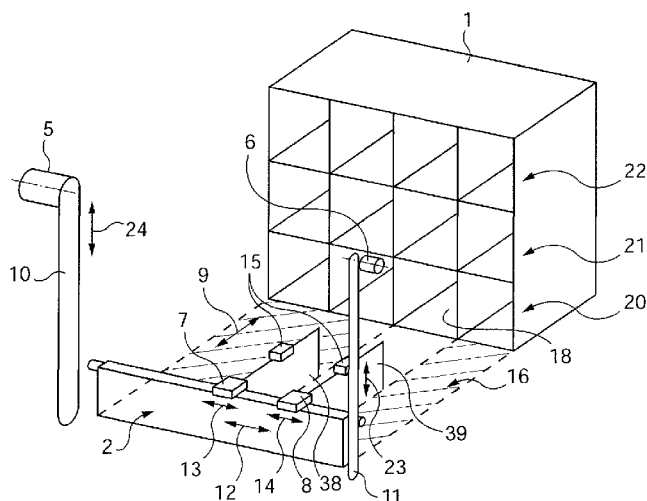
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(52) **U.S. Cl.**

CPC . **B65G 1/06** (2013.01); **B64D 9/00** (2013.01);
B64D 11/0007 (2013.01); **B64D 11/04**
(2013.01)

(58) **Field of Classification Search**

CPC B65G 1/06; B64D 11/0007



(51) **Int. Cl.**

B64D 11/04 (2006.01)

B64D 11/00 (2006.01)

FOREIGN PATENT DOCUMENTS

EP	0443897 A1	8/1991
FR	2 228 688	12/1974
GB	2131779 A1	6/1984
WO	WO 2008/070835 A1	6/2008
WO	WO 2012/025673	3/2012

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,923,612 B2 *	8/2005	Hansl	414/277
7,331,544 B1	2/2008	Harrington et al.	
2005/0133308 A1	6/2005	Reysa et al.	
2006/0186268 A1 *	8/2006	Harrington et al.	244/118.5
2007/0286711 A1 *	12/2007	Hashimoto et al.	414/217
2008/0035792 A1	2/2008	Harrington et al.	
2009/0028675 A1	1/2009	Tsujimoto et al.	

OTHER PUBLICATIONS

Chinese Search Report for Application No. 201180040605.8 dated Oct. 24, 2014.

* cited by examiner

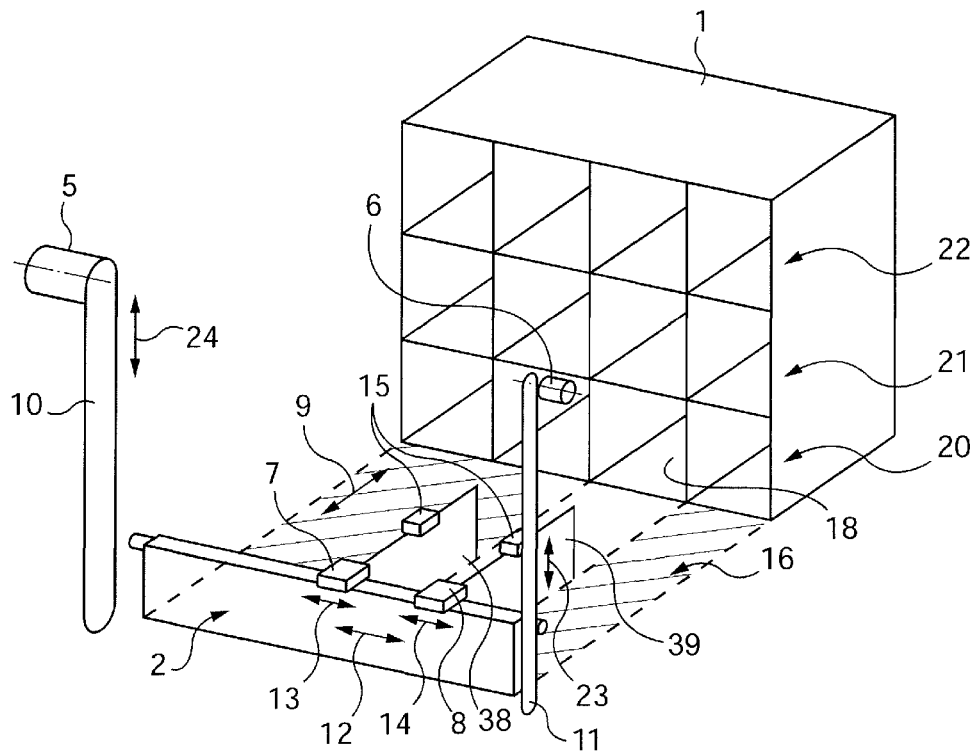


Fig. 1

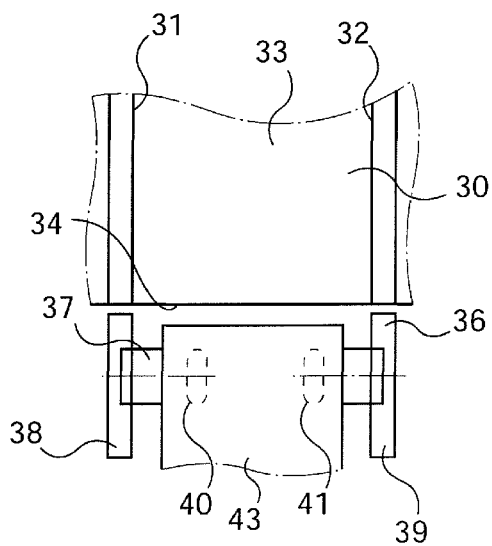


Fig. 2

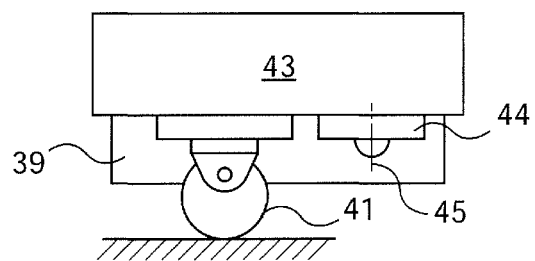


Fig. 3

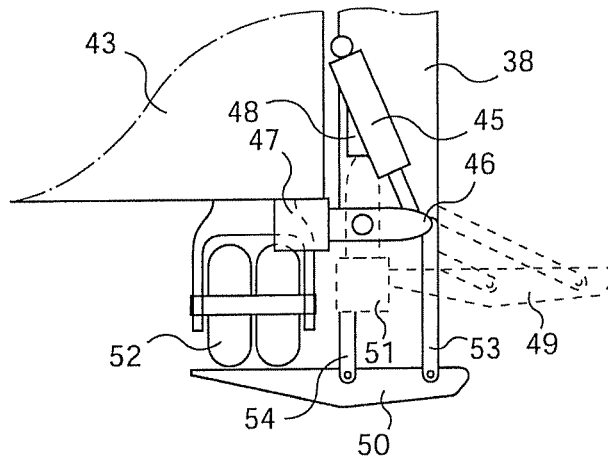


Fig. 4

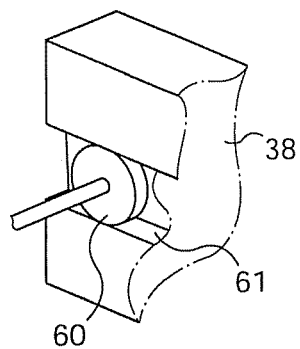


Fig. 5

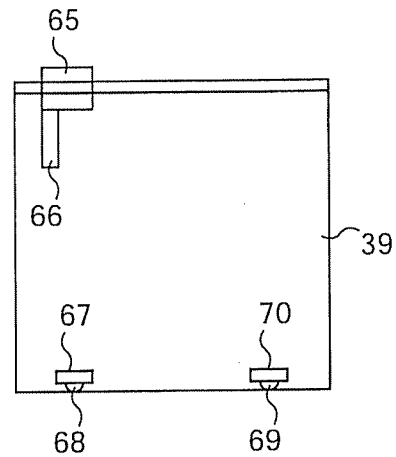


Fig. 6

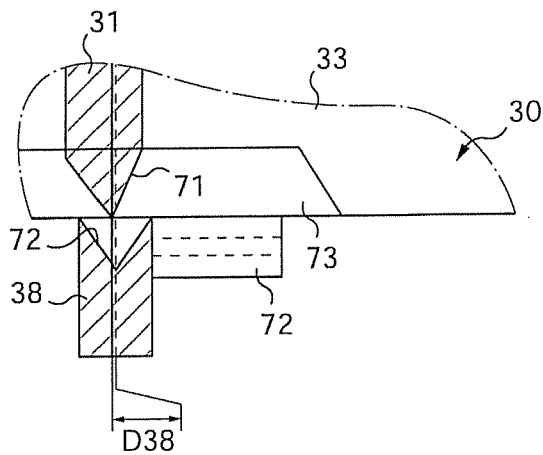


Fig. 7

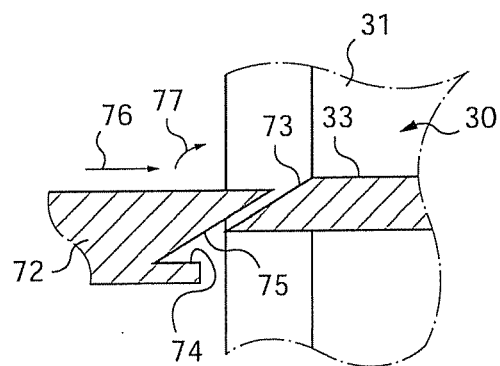


Fig. 8

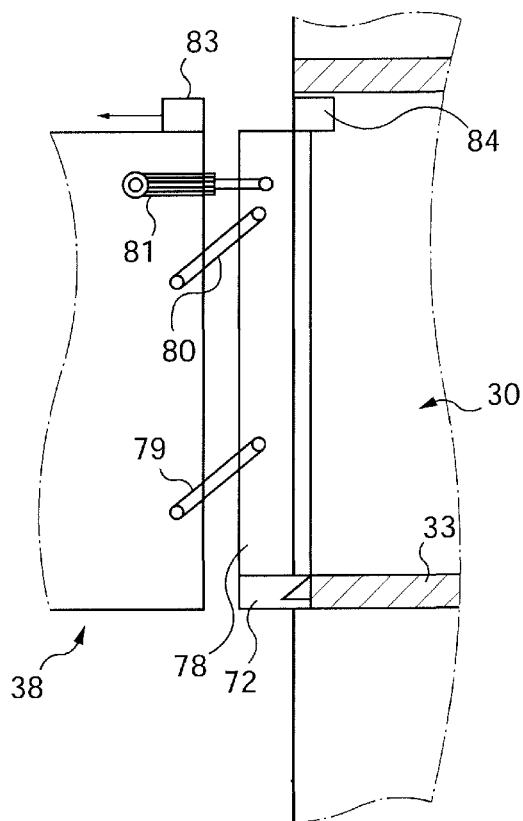


Fig. 9

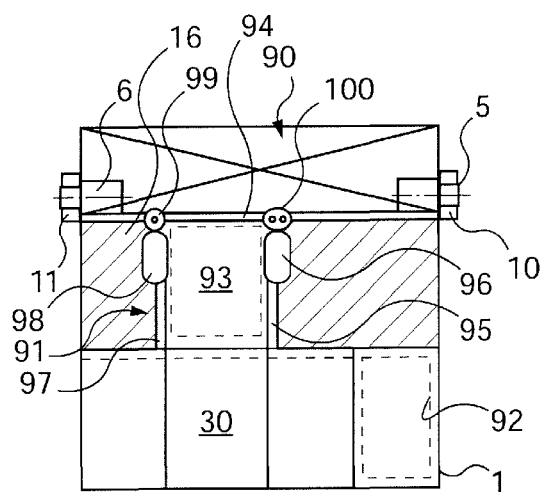


Fig. 10

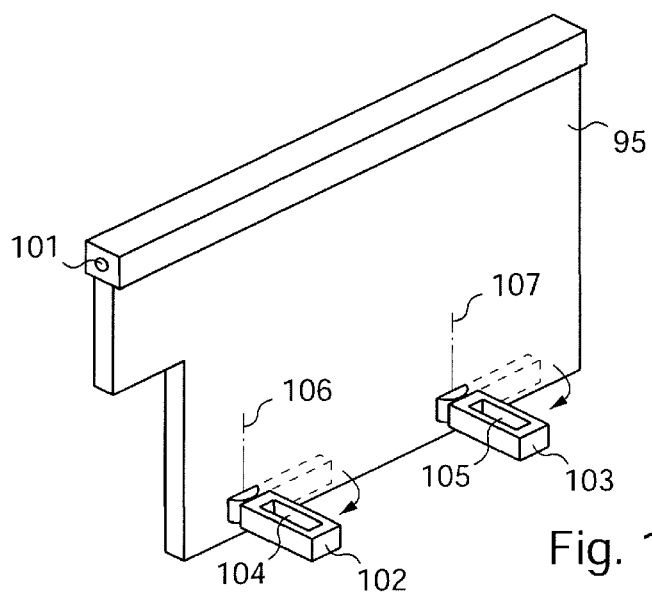
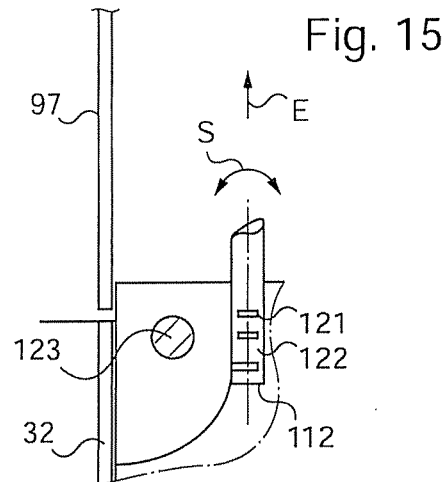
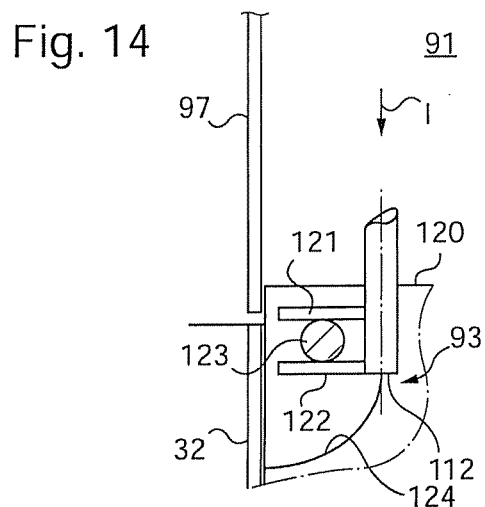
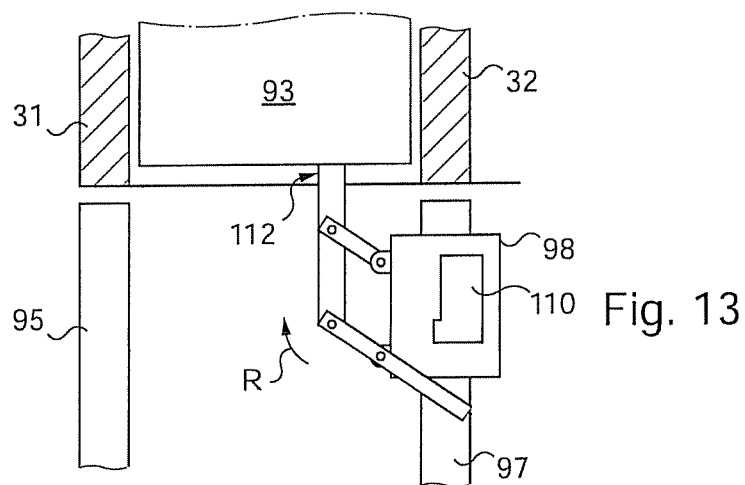
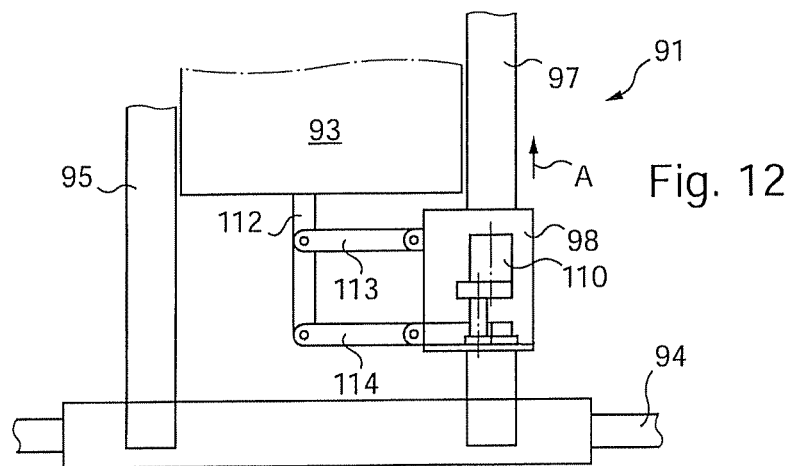


Fig. 11



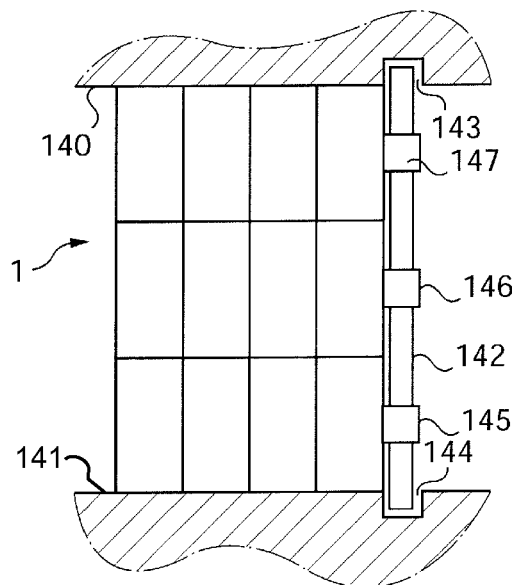
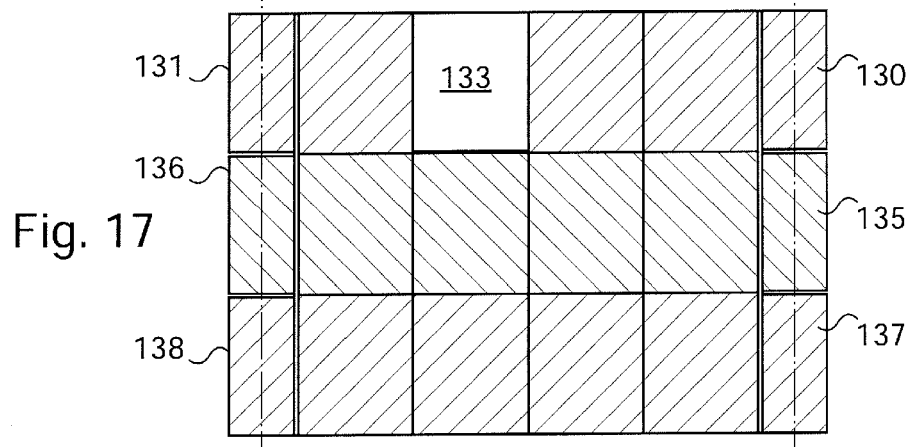
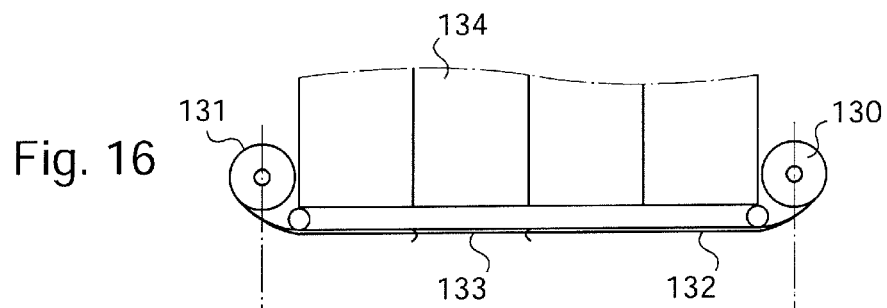


Fig. 18

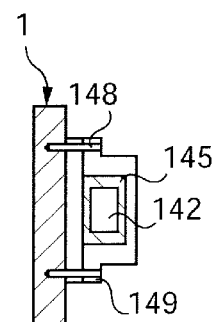
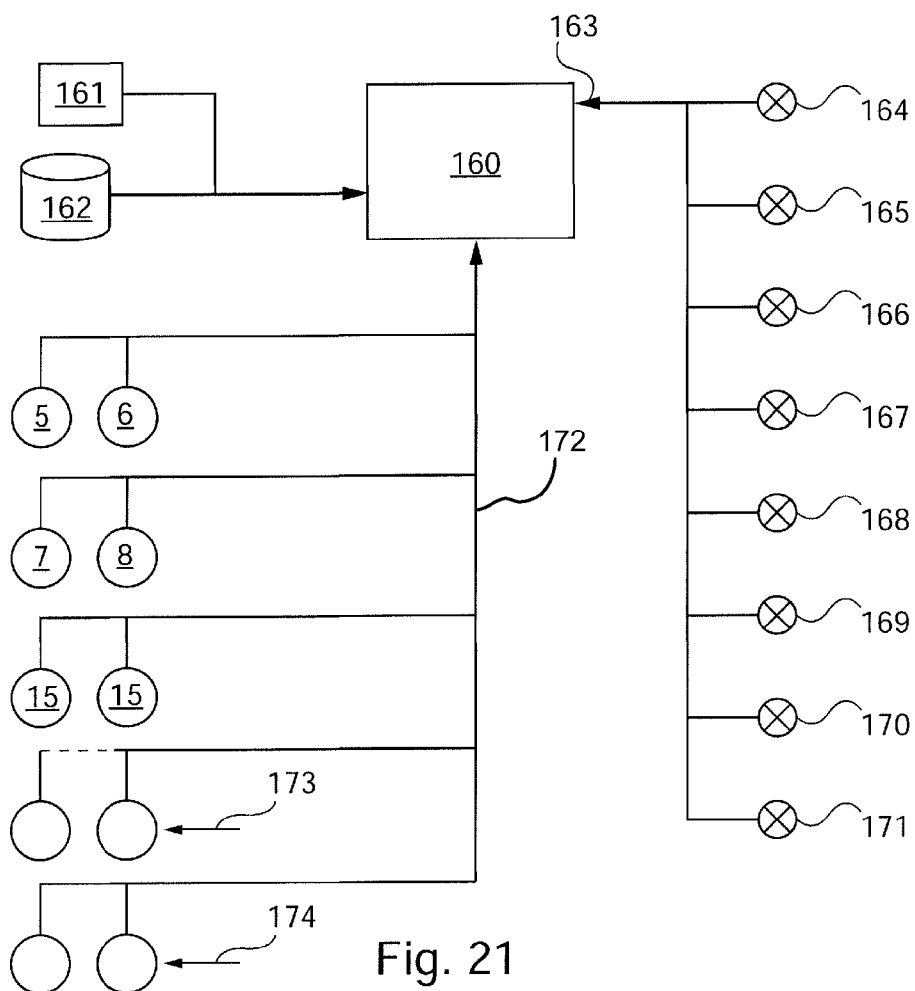
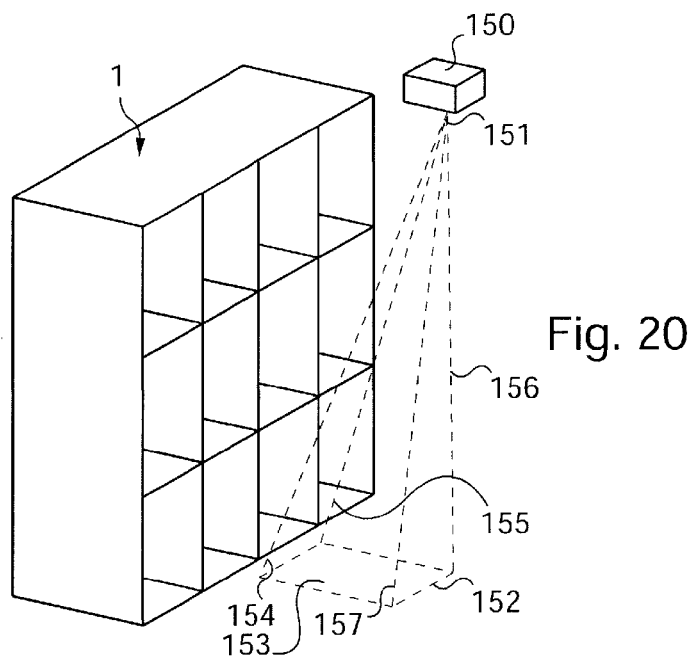


Fig. 19



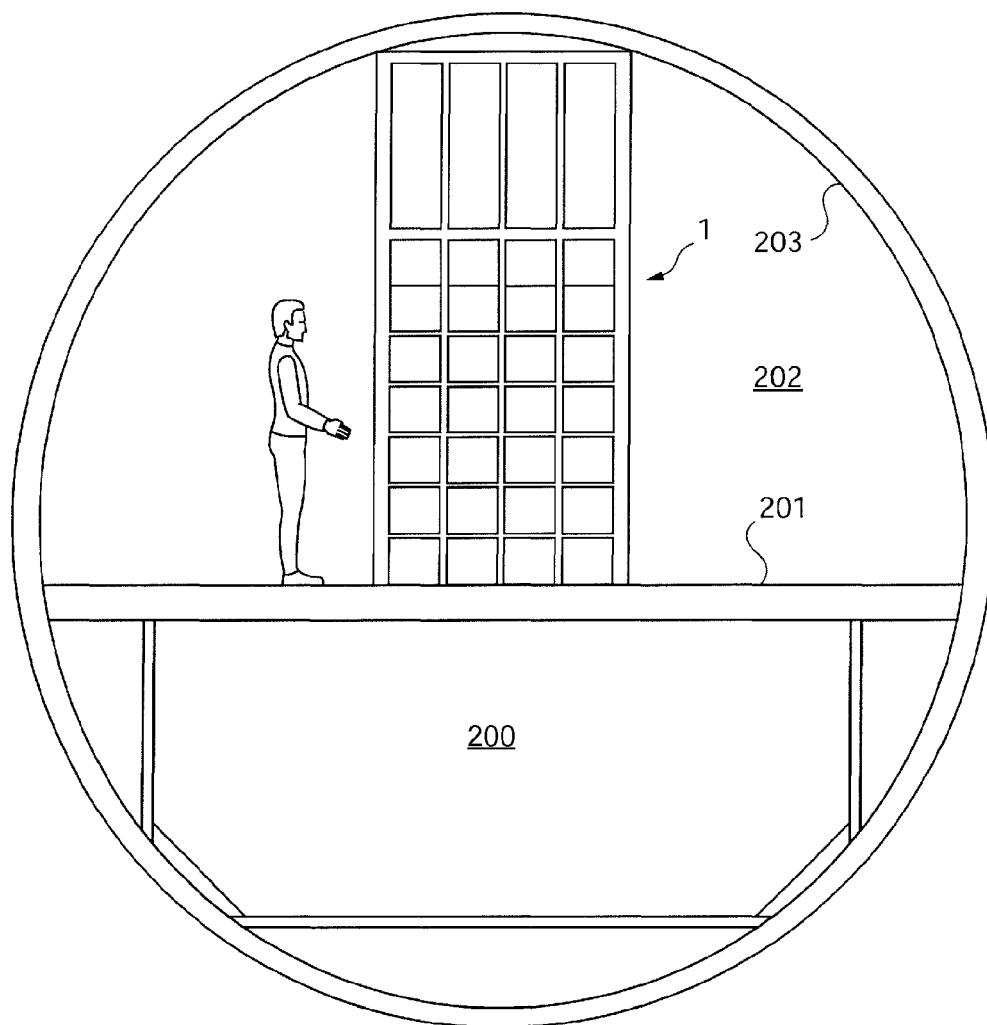


Fig. 22

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AUTOMATED STORAGE CABINET FOR TROLLEYS, AND AIRCRAFT INCORPORATING SUCH A CABINET

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of PCT application serial No. PCT/FR2011/000471 filed Aug. 23, 2011, which claims priority to French Patent Application No. 1056733, filed Aug. 24, 2010, the entire contents of which are both incorporated by reference herein.

TECHNICAL FIELD

The present invention relates to an automated storage cabinet for trolleys. It also relates to an aircraft incorporating such a cabinet. It finds application in the fields of aircraft manufacture as well as the equipment of commercial aircraft.

BACKGROUND

In the state of the art, it is known to use kitchens or “galley”, in which a cabinet makes it possible to store trolleys which are intended for distributing drinks and refreshments as well as, if applicable, prepared meals in the aisle of an aeroplane of a passenger airline.

The meal distribution trolleys generally have a parallel-pipedic shape. A meal distribution trolley runs on four wheels fixed to the base of the trolley. Handles allow the stewards and flight attendants to take the meals and refreshments to be distributed along the aisle between the rows of passenger seats.

Before this use, the trolleys are made up, for example in the air terminal, then stored in a hold, below the passenger deck. When the cabinet containing the trolleys is empty, new full trolleys are inserted, which are subsequently distributed during the flight.

In order to carry out this loading procedure, it is known to use a kind of lift, passing through the floor of the passenger deck, and making it possible to take one or more meal distribution trolleys from the hold to the cabin or passenger deck. The trolleys awaiting distribution are then stored in a trolley storage cabinet on a single level, at the level of the floor of the cabin. The used trolleys are then taken down into the hold by reversing the operation.

Such a state of the art is for example represented by the documents EP-A-0443897, GB-A-2.131.779, US2006/0186268. It has in particular the drawback of requiring a hole to be made through the floor of the passenger deck, which weakens its structure, unless it is reinforced with an additional special arrangement.

In another state of the art, it is known to use trolley storage cabinets comprising at least two superimposed levels of trolley storage drawers. Particularly in order to access the trolleys stored on the upper level above the floor of the cabin, a horizontal platform is used, which is then raised to the desired level in order to extract one or more trolleys from, or introduce one or more trolleys into, the storage compartment.

Such a state of the art is in particular presented by the document WO 2008/070835. However, this state of the art does not make it possible to load a drawer on a higher level with a trolley if this drawer is not situated close to a side pillar which serves as a lift. A situation of this kind is also represented by the document US2005/0133308.

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It is not possible to access a particular trolley in this way. Moreover such a solution has a particularly high space requirement since an area has to be reserved in the meal distribution trolley storage cabinet in order to arrange therein the lift which makes it possible to access a single upper level.

Moreover, the use of a horizontal lifting platform as lift, especially in the case where several trolleys have to be lifted at the same time, can result in bending of the horizontal platform and also result in sagging of the cabinet itself.

SUMMARY

The present invention remedies at least one of the drawbacks of this state of the art. In fact, the present invention relates to an automated trolley storage cabinet in a supporting structure, said trolley storage cabinet comprising at least two levels of compartments each intended for storing a trolley, characterized in that it comprises in particular a device for automatically handling a single trolley between:

- a waiting area, arranged on a floor of the supporting structure and adjacent to openings of trolley storage compartments of said trolley storage cabinet, and
- a predetermined compartment at a predetermined level of the trolley storage cabinet,

the handling device comprising a handling basket comprising:

- a vertical plate perpendicular to the waiting area, vertically movable between the floor of the waiting area and any one of the levels of the trolley storage cabinet, and
- two side flanks, firmly fixed to the vertical plate and provided with means for supporting, on either side, two opposite sides of a trolley in the waiting area and for transferring the supported trolley through an opening of the predetermined compartment, the vertical plate bearing motor means for producing a relative lateral displacement of the two side flanks,

the handling device being provided with means for inserting the trolley into or extracting it from the predetermined compartment.

An advantage of this arrangement is that it allows access to any compartment of the storage cabinet at any level in the cabinet. Furthermore, it is also possible to use the entire volume of the storage cabinet to store trolleys therein (for example meal distribution trolleys), the handling mechanism being completely outside the volume of the cabinet, even during the insertion and/or the extraction.

Finally, the relative lateral displacement of the side flanks makes it possible to adapt to the different trolley dimensions. An advantage of this arrangement is that it makes it possible, by gripping the side flanks, to ensure a perfect alignment of the meal distribution trolley with respect to a longitudinal dimension of the destination compartment which serves as the insertion and/or extraction direction.

According to other advantageous characteristics:

- the vertical plate is mounted on motor means and configured in order to confer a vertical movement on the vertical plate;

- the vertical plate bears motor means for producing a displacement of both side flanks together;

- the means for transferring the supported trolley through an opening of the predetermined compartment comprise motor means for allowing the transfer of the trolley between a position situated between the side flanks and the predetermined compartment or vice versa;

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the motor means are actuated under the control of a control unit cooperating with sensors of the displacement of moving parts and means of control in particular for selecting a predetermined compartment;

the motor means of vertical movement of the vertical plate are duplicated on each side of the vertical plate in such a way that the control unit connected to horizontality sensors of the trolley controls said horizontality; an advantage of this arrangement is that it makes it possible to control the horizontality at least in the direction perpendicular to the direction of insertion and/or extraction of the trolley, which improves the balance of the handling device;

the means for supporting, on either side, two opposite sides of a trolley comprise a plurality of removable stops, each removable stop being driven by a motor and being mobilized by the control unit in order to come into position under the base of the trolley during the greater part of the transfer of the trolley between the waiting area and the predetermined compartment; an advantage of this arrangement is that it makes it possible to transfer the weight of the trolley on the two side flanks while ensuring the passage of parts projecting from the base of trolley such as the wheels during the movements of insertion into and/or of extraction from a predetermined compartment;

the means for transferring the supported trolley through an opening of the predetermined compartment also comprise a device for pushing or extracting a trolley through the opening of said predetermined compartment; an advantage of this arrangement is that it makes it possible to avoid the side flanks of the handling basket entering into the compartment in order to completely insert the whole trolley into it, which would increase the width of the compartment by at least the thickness of each of the side flanks. Furthermore, it is possible to push the front face of the trolley as far as necessary through the opening of the chosen compartment, by calculating the extension of the pusher-extractor device;

the side flanks comprise edges intended to fit parts opposite walls of the predetermined compartment, each edge comprising a centring means intended to engage with a suitable profile of said part of wall opposite the predetermined compartment; an advantage of this arrangement is that it ensures the centring of the handling basket on the compartment chosen for the insertion and/or extraction of the trolley while ensuring the continuity between the handling basket and the compartment during this handling;

the automated cabinet comprises a means for projecting onto the floor an image of a mark for alignment of a trolley in the waiting area under the control of the control unit, the alignment of the trolley facilitating the positioning of the handling basket around the trolley; an advantage of this arrangement is that it makes it possible to mark by program any part of the waiting area and thus to ensure an aid for aligning two edges of the trolley before it is gripped by the two flanks of the handling basket, these two flanks achieving its alignment in order to allow its insertion into a compartment of the storage cabinet, which allows tighter dimensions of the compartment around the trolley;

the automated cabinet comprises at least one roller mechanism for a flexible wall rolled up on either side of at least one level of compartments of the cabinet; an advantage of this arrangement is that it ensures that at

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least one of the levels of the storage cabinet is kept cold while arranging an access door to the predetermined compartment when a trolley is to be inserted or extracted;

the automated cabinet comprises at least one stiffening rod; an advantage of this arrangement is that it increases the rigidity of the supporting structure with the aid of that of the storage cabinet, while making it possible to reduce the quantity of material and therefore the dimensions of the cabinet for a given number of trolleys. The rod also makes it possible to add rigidity without increasing the dimensions of the cabinet.

According to another aspect of the invention, the invention relates to an assembly comprising a floor of a supporting structure of a cabinet and an automated cabinet according to the invention

According to another aspect of the invention, the invention relates to an aircraft incorporating at least one automated trolley storage cabinet of an aircraft according to the invention, the trolleys being for example aircraft cabin galley trolleys.

It will be noted that the handling device according to the invention can be used for handling other types of trolleys or removable containers intended to be arranged in a cabinet with compartments.

Among other technical characteristics of the present invention, the following points are noted:

the removable stops of the means for supporting, on either side, two opposite sides of the trolley comprise roller levers and/or deformable parallelograms with bars;

the pusher-extractor device comprises a deformable parallelogram;

the deformable parallelogram of the pusher-extractor device cooperates with a key intended to engage with a part projecting from the trolley at least during a phase of extraction of the trolley through the opening of the compartment under the action of motor means controlled by said control unit;

the roller mechanism for a flexible wall is such that the flexible wall is made of a thermally insulating material and closes the openings of the compartments of said level;

the flexible wall comprising at least one opening which is displaced by a motor connected to the roller mechanism under the control of the control unit so that a predetermined compartment is accessible through said opening;

the stiffening rod comprises a tube with a rectangular cross-section, firmly fixed to a side wall of the cabinet by bearings of low-friction material, and anchored to the floor and to the ceiling of the supporting structure of the cabinet so as to stiffen said structure.

BRIEF DESCRIPTION OF THE DRAWINGS

Other characteristics and advantages of the present invention will be better understood with the help of the description and attached figures in which:

FIG. 1 is a diagrammatic perspective view of an automated cabinet in a preferred embodiment of the present invention;

FIGS. 2 to 6 are execution details of parts of the cabinet of FIG. 1;

FIGS. 7 to 9 are diagrammatic views of arrangements ensuring the centring of the handling basket on a compartment;

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FIGS. 10 and 11 are respectively a diagrammatic top view of a particular embodiment of an automated cabinet according to the invention and a diagrammatic perspective view of an arrangement used in FIG. 10;

FIGS. 12 and 13 are two diagrammatic views of a pusher-extractor device of the handling basket during a phase of pushing into the handling basket in FIG. 12 and out of the handling basket in FIG. 13, a partial cross-sectional view of this same part;

FIGS. 14 and 15 are diagrammatic cross-sectional views of two states of a key used by the pusher-extractor device of FIGS. 12 and 13;

FIGS. 16 and 17 are respectively a top view and a front view of an arrangement of doors ensuring the refrigeration sealing of the storage cabinet of the invention in a particular embodiment;

FIGS. 18 and 19 are diagrammatic views of a particular arrangement for a cabinet according to the invention;

FIG. 20 is a diagrammatic perspective view of another arrangement for a cabinet according to the invention;

FIG. 21 is a diagram explaining the control of the automated cabinet of the invention; and

FIG. 22 is a location plan of an automated cabinet according to the invention in an airliner.

In FIG. 1, the automated trolley storage cabinet of the invention is diagrammatically represented under reference 1.

DETAILED DESCRIPTION

In FIG. 22, the automated trolley storage cabinet 1 is shown in a cross-section of the fuselage of an airliner. It is set up on a hard surface 201, separating a hold 200 from a passenger cabin 202. The automated cabinet 1 extends up to the roof section 203 of the cabin 202 and it is dimensioned so as to optimize the occupation of the volume available in the cabin. In practice, the fuselage of the aircraft serves as supporting structure for the automated trolley storage cabinet. It is understood that such a cabinet can be mounted on other supporting structures, such as the hold of an aircraft, the cabin of a railway wagon, a salon of a cruise ship, or any other vehicle.

Such a cabinet is arranged for example in a cabin galley of an aircraft. Again with reference to FIG. 1, the trolley storage cabinet 1 has at least three levels 20-22 of compartments in each of which a trolley is intended to be arranged as described previously.

The automated cabinet of the invention comprises in particular a device for automatically handling a single trolley. The automatic handling provided by the invention essentially consists of transferring a predetermined trolley between a waiting area 16 arranged on the floor of the cabin of the aircraft and the opening of a compartment such as the compartment 18 at the level 20 of the trolley storage cabinet. The waiting area 16 is intended to receive at least one trolley when it is to be loaded into a compartment or also before it is taken by a steward in order to serve meals and refreshments in an aisle of the aeroplane via one of the right or left edges of the waiting area 16. The device for automatically handling a single trolley comprises a handling basket mainly comprising a vertical plate 2 bearing two side flanks, 38 and 39 respectively.

The vertical plate 2 is perpendicular to the waiting area 16 and for example has a substantially rectangular shape having a long horizontal dimension and a short vertical dimension. The vertical plate is vertically movable, because it is mounted on motor means 5, 6 arranged for example in the vicinity of the waiting area on the other side of the cabinet

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1. In a preferred embodiment, the motor means 5, 6 of the vertical plate 2, vertically driving the vertical plate 2, are arranged on either side of the vertical plate 2. They comprise an endless chain 10 mounted between the ceiling and the floor of the cabin to the left of the vertical plate and an endless chain 11 mounted between the ceiling and the floor of the cabin and arranged to the right of the vertical plate 2.

In a particular embodiment which will be described in more detail below, the vertical plate 2 makes it possible to control the horizontal direction of a trolley which is firmly fixed, as will be described below, to the vertical plate by making the two endless chains 10 and 11 work differentially according to the respective vertical movements 23 and 24. To this end, the motor means 5 and 6 are independently controlled by the control unit of the automatic handling device, which will be described below. Each motor 5 or 6 receives a command from the control unit at different speeds thus ensuring a rapid return to the horizontal condition of the meal distribution trolley.

The vertical plate 2 also bears two side flanks 38 and 39 which are intended to grip a meal distribution trolley, arranged in the waiting area, in order to then transfer it from the waiting area 16 to a predetermined compartment of a predetermined level 20-22 in the trolley storage cabinet 1. To this end, each side flank 3 or 4 is firmly fixed to the vertical plate 2. Each side flank 38 or 39 is driven by motor means 7, 8 firmly fixed to the vertical plate and comprising a motor mounted on a carriage movable on a rack or rail of the vertical plate. Thus, it is possible to displace each of the side flanks along the horizontal dimension of the vertical plate 2, in independent manner horizontally according to the movements 13 and 14. The automatic handling device of the invention is therefore capable of covering the entire volume comprised above the waiting area 16. Preferentially, the side flanks 38 and 39 extend longitudinally from the vertical plate 2 as far as the front faces of the compartments of the trolley storage cabinet 1.

Each side flank 38 or 39 also bears motor means 15 which are removably connected to the meal distribution trolley being handled by a trolley pusher and/or extractor device according to the movement 9.

A description will now be given of a scenario of loading a meal distribution trolley from the waiting area to a compartment of the trolley storage cabinet 1.

When a trolley (not shown) is detected in the waiting area 16, a control unit (not shown in FIG. 1) controls the motor means of the single-trolley automatic handling device so that the vertical plate 2 descends from a parked or resting position (not shown in FIG. 1) down to a low position while moving each side flank 38 or 39 towards one of the two opposite sides of the meal distribution trolley.

Once the flanks 38 and 39 are arranged on either side of the side walls of the trolley and are in contact with these, the control unit actuates a movement of gripping the flanks so that the trolley is then oriented parallel to the greatest dimension (e.g. the depth) of a compartment into which it is to be loaded (the trolley is oriented in the direction of the longitudinal extension of the flanks). In a subsequent step, the vertical plate is raised when actuated by the control unit (not shown) of the automatic handling device of the invention up to the desired level 20-22. The motor means 7 and 8 of the side flanks 38 and 39 are then actuated simultaneously so as to displace the trolley sideways according to the movement 12 and position it in front of the opening of the predetermined compartment 18 into which it is to be inserted.

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Finally, in a last step, the trolley transfer motor means, such as the motor means **15** on the flank **38**, are actuated by the control unit of the automatic handling device of the invention, so as to push the meal distribution trolley inside the compartment. The handling basket of the automatic handling device can then return to the parked position.

The procedure for extraction of a meal distribution trolley from a predetermined compartment in a predetermined level **20-22** of the trolley storage cabinet **1** is the strict reverse of the insertion procedure which has just been described and will not be described further.

It will be noted that, during the horizontal translational movement **12** of the two flanks so as to bring the trolley in front of the opening of a predetermined compartment, the gripping of the flanks is constantly controlled by the control unit of the handling device of the invention.

It is also noted, as discussed in more detail below, that all of the movements are monitored using a network of displacement sensors so as to ensure that the meal distribution trolley is presented precisely in the axis of the opening of the predetermined compartment at the predetermined level.

FIG. 2 shows the end of the approach of a handling basket bearing a meal distribution trolley **43**, partially showing a left side flank **38** and a right side flank **39** gripping the trolley. The basket thus constituted has been moved towards the front face **34** of a chosen compartment **30** on a predetermined level of the storage cabinet. The compartment **30** is limited in particular by a base wall **33** and two side walls **31** and **32** which separate the compartment **30** from its neighbours in the same level of the trolley storage cabinet. The two side walls and the base wall (as well as the top wall not shown in this figure but which is parallel to the base wall) define the longitudinal dimension (depth) of the compartment.

The meal distribution trolley has castors such as the wheels **40** and **41** (in dotted lines) under the base of the trolley, which are intended to run on the base **33** of the compartment.

It is noted that the automatic handling device is programmed so as to arrange the ends of the left flank **38** and of the right flank **39** precisely in continuity with the side walls **31** and **32** of the compartment (in alignment with their respective longitudinal directions). It is thus possible to limit the internal width of each compartment to the width of the trolley, within tolerances.

The left **38** and right **39** side flanks have means for translational movement of the trolley to the compartment. In an embodiment, the means for translational movement or transfer of the meal distribution trolley in the side flanks comprise, for the right flank **39**, a rack **36** and, shown on the left flank **38**, a movable carriage **37**. The movable carriage **37** is of course duplicated on the right side flank **39** and enters into its own rack on the inner surface of the left side flank **38**.

When the automatic handling device of the invention actuates the insertion of the trolley through the front face **34** of the compartment **30**, the electric motor of each movable carriage such as the carriage **37** is actuated so that the meal distribution trolley **43** is inserted through the front face **34** of the compartment **30**.

During extraction, the same movement is actuated in reverse, each carriage such as the movable carriage **37** performing a reversed movement.

Sensors (not shown in FIG. 2) are provided and make it possible to detect:

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the alignment of the left **38** and right **39** side flanks side flanks with the side walls **31** and **32** of the compartment **30**;

the end of travel of the meal distribution trolley **43** inside the compartment **30** or inside the handling basket comprising the left **38** and right **39** side flanks.

FIG. 3 diagrammatically shows an arrangement complementary to the handling basket shown in FIG. 2. The meal distribution trolley **43** is gripped between the side flanks, only the side flank **39** of which has been shown for the sake of simplicity. The base of the trolley **F** bears in particular a wheel or castor **41** and the side flank **39** bears, on its face inside the handling basket, an axis of retraction **45** of a stop **44**. The stop **44** is retracted by a motor means, such as a cylinder, in particular in order to allow the wheel **41** to pass through during the insertion or extraction of the meal distribution trolley **43** through the open front face of the compartment. The motor means for retraction of a stop such as **44** can be actuated by the control unit of the automatic handling device of the invention. The stop makes it possible to support the weight of the meal distribution trolley **43** in the handling basket, when the right and left flanks are gripped around it. Several retractable stops such as the stop **44** are arranged along each side flank such as the right side flank **39**. In a particular embodiment, the stop **44** bears a roller intended to roll under the base of the trolley **F** in order to facilitate the transfers of the meal distribution trolley in the handling basket.

FIG. 4 shows another embodiment of an arrangement shown in FIG. 2 and in FIG. 3. The meal distribution trolley **43** is partially represented with a double castor **52**, mounted on its base **F**. At least three other castors (not shown) are arranged at the other corners of the meal distribution trolley with a substantially rectangular cross-section. The handling basket, gripping the meal distribution trolley, comprises the right and left side flanks, of which only the left side flank **38** is shown. A stop, comprising an articulated lever **46** and a castor **47**, is shown fitted to the base **F** of the trolley. The articulation of the castor is firmly fixed to the side flank **38** and is mobilized by a cylinder **45** which can be actuated under the action of the control unit of the automatic handling device of the invention. When the castor **47** is retracted, it passes into the vertical position **51**, shown in FIG. 4.

According to another arrangement, also shown in FIG. 4 and which may or may not be combined with the castor **47**, a deformable parallelogram **49**; **50** is provided and is intended to raise the wheels **52** of the trolley and to support them throughout the period when the meal distribution trolley is situated inside the handling basket, constituted in particular by the two right **39** and left **38** side flanks. To this end, the deformable parallelogram, shown in solid lines in the deployed position **50**, comprises bars **53** and **54** articulated on a running surface **50** and which are mobilized by a cylinder partially represented as **48** in FIG. 4. When the cylinder **48**, actuated by the control unit of the automatic handling device of the invention, is deployed, the deformable parallelogram passes from the retracted position **49** (shown in dashed lines) to the deployed position **50** in which the wheels **52** are raised above the ground. The meal distribution trolley **43** is then supported in the handling basket, in particular using the parallelogram in position **50** until it touches the floor of the cabin or the base of a compartment of the storage cabinet of the invention.

FIG. 5 shows another arrangement making it possible to ensure the insertion or the extraction of the meal distribution trolley vis-à-vis the basket constituted in particular by the right and left flanks to the compartment in the storage

cabinet or vice versa. Each right or left side flank, such as the flank **38** partially represented in FIG. **5**, comprises a rack on its inner surface **61** and which is intended to receive a gear wheel **60** driven by a motor connected to a movable carriage. The movable carriage, not shown in FIG. **5**, cooperates with a pusher and/or extractor device in relation with the actual meal distribution trolley. The movable carriage on the right and/or left side flank can be controlled by the action of the control unit of the automatic handling device of the invention.

FIG. **6** shows a diagrammatic view of the side flank **39** of FIG. **5**. A motorized trolley **65**, firmly fixed to the rack **61**, drives the pusher and/or extractor device **66** linked to the meal distribution trolley (not shown in FIG. **6**). The inner surface of the side flank **39** also bears two stops **67** and **70** respectively mounted on pivots **68** and **69** as means for supporting, on either side, two opposite sides of a meal distribution trolley.

When the meal distribution trolley to be inserted into or extracted from a compartment is arranged between the flanks of the handling basket, such as the side flank **39** (FIG. **6**), the pusher-extractor device **66** linked to the meal distribution trolley is driven from right to left or from left to right so as to drive the meal distribution trolley from the compartment to the handling basket or from the handling basket to the compartment.

FIGS. **7** and **8** show an arrangement making it possible to ensure that the flank **38** is brought into contact with the corresponding side wall **31** of the compartment **30** during the approach of the handling basket. As the basket is composed of two left **38** and right **39** side flanks, the same arrangement is provided for the right side flank **39** which is not shown in FIGS. **7** and **8**. FIG. **7** shows the end of the left side flank **38** during its phase of approaching the compartment **30**. The compartment **30** has a side wall **31** separating it from the neighbouring compartment and the edge of which on the side of the front face **34** has a wedge-shaped or bevel section **71**. The bevel **71** is intended to penetrate a dihedral formed on at least one part of the lateral edge of the flank **38** facing the wall **31**. As the axes of the bevel **71** and of the dihedral are not perfectly aligned (gap denoted D38), the contact of the bevel **71** with one of the flanks of the dihedral corrects the alignment of the assembly (lateral self-alignment of the basket and the compartment). Similarly, the left side flank **38** bears an angle **72** which is intended to fit into a bevel **73** arranged on the lower surface or wall **33** of the compartment **30** close to the separating wall **31**.

FIG. **8** shows the situation of the approach of the basket in which the angle **72** has an inclined part which connects to a lug **74**. The inclined part **75** is intended to slide over the bevel **73** of the edge of the base wall **33** of the compartment **30**. During the approach **76**, when the bevel **73** meets the inclined part **75**, a movement of alignment **77** makes it possible to bring the handling basket level with the base **33** of the compartment (vertical self-alignment of the basket and the compartment). It will be noted that other means of lateral and/or vertical self-alignment of the basket and of a compartment can be envisaged.

In these arrangements of FIGS. **7** and **8**, the vertical plate of the handling basket of the automatic handling device (not shown in FIGS. **7** and **8**) allows the driving in correspondence of the two side flanks of the basket towards the corresponding walls of the destination compartment **30**. However, the rigidity of the assembly involves the arrangement of a certain mechanical operating clearance making it possible to overcome misalignments such as the misalignment D38 in FIG. **7** or that visible on the angle **72** with the

base **33** in FIG. **8**. In order to avoid having to resort to clearances, the arrangement in FIG. **9** uses a bar **78** mounted in the form of a parallelogram deformable using articulated bars **79** and **80** and a mobilization cylinder **81** with the corresponding edge of the side flank **38** shown. During the approach, sensors **83** and **84** make it possible to detect the juxtaposition of the basket with the compartment **30**. At a predetermined detection signal, the automatic handling device, via a control unit provided for this purpose, issues a command activating the cylinder **81** and the bar **78** which bears the dihedral and the angle **72** is simultaneously applied to the side wall **31** and the base **33** of the compartment **30**.

FIG. **10** shows a top view of another embodiment of a cabinet for storing trolleys (for example trolleys according to the invention) incorporating an automated handling device for meal distribution trolleys. The automated handling device comprises a handling basket **91** which is mounted on vertical translational movement means **6**, **11** and **5**, **10** to the left and to the right respectively of a cabinet **90** (for example, a galley cabinet). The cabinet **90** is arranged on one side of a waiting area **16** the opposite side of which is bordered by the trolley storage cabinet **1**. The trolley storage cabinet comprises compartments, such as the compartment **30**, distributed on different levels and a meal distribution trolley **92** is shown stored inside the compartment furthest to the right (FIG. **10**).

The handling basket **91** comprises mainly the vertical plate **94** mounted on the vertical displacement motor means **6**, **11** and **5**, **10**, and two side flanks **95** and **97** respectively. The side flanks **95** and **97** ensure the two functions of laterally transporting the meal distribution trolley **93** above the waiting area **16** and gripping the trolley **93**. Moreover, once the flanks have been arranged on either side of the trolley **93** the handling basket is transferred under the actuation of the control unit of the handling device of the invention to the front face opening of a predetermined compartment at a predetermined level of the trolley storage cabinet. To this end, the side flank **97** is driven by a horizontal translational movement motor means **99** on the vertical plate **94** and bears a drive carriage for insertion and of extraction **98** of the trolley **93**. The side flank **95** is driven by a horizontal translational movement motor means **100** on the vertical plate **94** and bears a drive carriage **96** for insertion and extraction of the trolley **93** vis-à-vis the compartment **30**.

In an embodiment example, the cabinet **90** is a galley cabinet incorporating the vertical motor means **6**, **11** and **5**, **10**. The cabinet **90** has a work surface, not shown, as well as storage shelves which make it possible to prepare refreshments to be loaded into the meal distribution trolley **93**.

FIG. **11** shows another view of a side flank, such as the side flank **95**, on the side of its face inside the basket **91**. The side flank **95** bears a rail **101** on which drive carriage will be mounted such as the carriage **96** which is not shown for the sake of simplicity. Moreover, two retractable movable stops **102** and **103** are shown in the deployed position of support of the base of the trolley when the side flank is arranged on one side of the trolley **93** in FIG. **10**. Each stop comprises a guide roller **104** on the stop **102** and a guide roller **105** on the stop **103**. A vertical axis, such as the axis **106** for the stop **102** and the axis **107** for the stop **103**, provided with motorization by a controllable cylinder allows the retraction of each of the stops into the position indicated in dotted lines. Particularly, each stop can be arranged in front of a wheel equipping the base of the trolley. When the insertion or the extraction of the meal distribution trolley vis-à-vis the

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compartment **30** takes place, this must be synchronized with the retraction of the stop, which would otherwise impede the relative movement of the trolley and of the flank during the insertion-extraction operation.

The movement of retraction of the stops such as the stops **102**, **103** is achieved using commands programmed by a control unit associated with the automatic handling device of the invention.

FIG. **12** shows a top view of the handling basket **91** comprising the vertical plate **94** and two left **95** and right **97** side flanks. In FIG. **12**, the meal distribution trolley **93** is shown in the position that it occupies when it has been installed between the side flanks on the waiting area and before the start of its transfer to the open face of a destination compartment. In a particular embodiment, a flank such as the right side flank **97** bears a drive carriage **98** which is mounted on a rail and a rack. This arrangement allows a longitudinal displacement in the direction of the arrow **A** of the drive carriage **98** from an insertion starting position at the level of the vertical plate **94** to a complete insertion position at the end of the flank **97** as represented in FIG. **13**.

The drive carriage **98** bears a deformable parallelogram **112-114** articulated on the carriage **98**. A rod **112** bears a device for linking to the meal distribution trolley for pushing or pulling the trolley **93** in the direction of the insertion or extraction movement of the trolley into or out of the compartment.

During the insertion movement the deformable parallelogram, which serves as pusher and/or extractor device, is in the contracted position, as shown in the figure. The drive carriage **98** performs its translational movement in the direction of the arrow **A** and the meal distribution trolley **93** is pushed upwards in FIG. **12** so that it enters the compartment through its open front face (not shown in FIG. **12**).

FIG. **13** shows the handling basket **91** when the meal distribution trolley **93** has been pushed and inserted completely inside the housing of the compartment comprised between the walls **31** and **32**.

In order to ensure that the trolley **93** is completely contained in the compartment, the deformable parallelogram is placed, by a motor or cylinder **110**, in a position or a completely extended state as represented in FIG. **13**. For this purpose, the motor or cylinder **110** has a rod **112** which pushes one of the bars of the deformable parallelogram back towards the rear. The deformable parallelogram undergoes a rotation **R** around the axes of its bars fixed to the carriage **98** so that the end of the rod **112** associated with the trolley **93** is at its position of furthest extension.

FIGS. **14** and **15** show an advantageous arrangement to be combined with the arrangement shown in FIGS. **12** and **13**. In fact, FIG. **14** is a partial top view of the basket **91** during the movement of insertion **I** of the trolley **93** through an opening of the destination compartment of the trolley in the trolley storage cabinet.

The rod **112** at the end of the deformable parallelogram, shown as a pusher and extractor device in FIGS. **12** and **13**, is equipped at its end that is in relation with the meal distribution trolley **93** with a rotating key comprising two rods **121** and **122**. The rod **112** can turn about its longitudinal axis, so that the rods **121** and **122** can enter a housing **124** of the front face **120** of the trolley **93**. The housing **124** contains a handle with a circular cross-section **123**, used by the stewards and flight attendants to manoeuvre the meal distribution trolley in the aisle between the passengers' seats. The same handle arrangement is provided at the four corners of the meal distribution trolley. Of course, any other

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part projecting from the front of the meal distribution trolley can be preferred for the key mechanism.

In order to make it possible to push (**I**) or pull (**E**) the meal distribution trolley **93** through the opening of the compartment, the key **121**, **122** has been turned in FIG. **14** so that the key and the handle **123** serve as fastening means between the handling basket **91** and the meal distribution trolley **93**.

It will be noted that the rod can alternatively be equipped with another type of fastener intended to cooperate with a complementary fastener of the trolley **93**.

FIG. **15** shows the pusher and/or extractor device when the trolley **93** has been pushed completely inside the destination compartment. The front face **34** of the destination compartment is then completely released. The final rod **112** of the pusher-extractor device, which comprises a rotating motorized mechanism, makes it possible to turn the rods **121** and **122** in the direction of the arrow **S**, so that the handle **123** of the meal distribution trolley is disengaged from the key **121**, **122**. It is then possible to carry out the withdrawal **E** of the deformable parallelogram which serves as pusher and/or extractor device and thus to withdraw the handling basket, the trolley **93** having been inserted completely into the destination compartment.

Of course the movement is reproduced precisely in reverse when it is desired to collect a meal distribution trolley **93** which is located in a compartment in order to place it in the waiting area.

FIGS. **16** and **17** show a diagrammatic top view and a diagrammatic front view of an arrangement improving the trolley storage cabinet according to the invention.

In fact, according to the principle of the mechanism of insertion and extraction of trolleys of the invention, the front face of each compartment of the storage cabinet or of the storage unit must be completely clear in order to allow the trolley to pass through to the basket of the automatic handling device. Frequently, the trolleys contain perishable foods that it is desirable to store with refrigeration means in the trolley storage cabinet, at the very least, at a constant low temperature. For this purpose, it is desirable for all the open front faces of the compartments to be closed during the greater part of the storage time of the trolleys in the storage cabinet. It must simply be ensured that the front face of a predetermined compartment is open at the time of insertion or the extraction of a trolley in the predetermined target compartment. For this purpose, the present invention proposes an arrangement in which each level of the cabinet is associated with a roller mechanism for a removable flexible wall that on command closes or clears, one or more of the openings of the compartments. In this regard, the flexible wall comprises one or more openings which, on command, can come into position opposite the openings of the compartments. For example, each level of the cabinet is associated with a pair of rollers **130**, **131** onto which is wound a thermally-insulating plastic film. The thermal film **132** has, over part of its length, a door **133** which comprises a simple opening having the precise dimension of the front, or opening, face of each compartment.

As shown in FIG. **16**, the part of the film including the door is arranged in the part of the unwound film situated between the rollers **130**, **131**.

When it is desired to protect the compartments from the cold loss, the door **133** is displaced completely into one of the rollers **130** or **131** (the part of the film comprising the door is rolled around this roller) so that a continuous film protects the different openings of the compartments of the level on which the rollers **130**, **131** are arranged.

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When the control unit, for example by executing a command on a user interface input by a steward, denotes a particular address of a predetermined compartment in the predetermined level, it generates a command on the motor of at least one of the rollers **130**, **131** so that the door **133** is displaced as far as the open front face of the destination compartment **134**. When the meal distribution trolley has been inserted into or extracted from said compartment, the door **133** is then again retracted into one of the rollers in the storage position.

FIG. **17** shows a front view of the cabinet protected by three pairs of rollers, respectively **130**, **131** on level **3**, **135**, **136** on level **2** and **137**, **138** on level **1**. Each pair of rollers can be controlled independently as a function of the destination compartment determined by the control unit.

FIGS. **18** and **19** show another arrangement making it possible to increase the rigidity of the supporting structure surrounding the trolley storage cabinet according to the invention. In fact, it is possible, thanks to the arrangement of the handling basket comprising the vertical plate and the two side flanks in the automatic handling device of the invention, to reduce the quantity of material so as to increase the number of trolleys that it is possible to store in the same trolley storage cabinet. However, this saving of material makes the storage cabinet **1** more fragile than in the state of the art and it is less capable of contributing to the rigidity of the structure. In order to increase this rigidity, the present invention proposes the use of at least one rod **142**, arranged between the roof section **140** of the cabin and the floor **141** of the cabin in recesses **143** and **144** provided for this purpose. The rod **142** is constituted by a single part with a rectangular cross-section as shown in FIG. **19** and which is passed through bearings **145**, **146**, **147** at different levels or heights of the cabinet. The same arrangement can be carried out on both sides or on a single side of the storage cabinet **1**.

FIG. **19** shows a cross-sectional view at the level of one of the bearings in which there can be seen the side wall of the cabinet **1** and the actual bearing **145** which surrounds the rod having a rectangular cross-section **142**. Fixings **148** and **149** are provided to connect the bearing **145** to the side wall of the storage cabinet **1**. The bearing is made of a material with a low friction coefficient so as to allow the rod to slide along the cabinet.

FIG. **20** shows another arrangement making it possible to ensure the operation of the automated cabinet according to the invention. In fact, it has been found that each trolley which is to be presented and inserted into a compartment of the cabinet **1**, must be gripped by the flanks of the basket and must therefore not present too wide an angle with respect to the longitudinal general direction (depth) of the compartments. For this purpose, the invention uses a projector **150** of an optical mark. The projector comprises a lens **151** through which are beams **154-157** are emitted, producing the image of a mark **152** on the floor of the cabin in the waiting area where the meal distribution trolley is situated awaiting insertion. The mark can take the form of a rectangle of light or a marking of the four corners of the trolley on which the trolley must be positioned. During this time, the handling basket, comprising the vertical plate and the two side flanks, is removed from the waiting area into a parked or resting position (not shown in FIG. **19**). The control unit of the automated handling device produces a command to switch on the projector **150** and the steward brings a trolley onto the mark **152** an orientation **153** of which is in accordance with that of the compartments. Once the trolley is arranged on the mark **152**, the basket of the automatic

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handling device leaves its parked position in order to grip, with its two side flanks, the corresponding sides of the trolley. The movement of insertion of the trolley into a predetermined compartment of a predetermined level can then commence.

FIG. **21** shows a control unit used by the automated handling device of the invention. The control unit **160** can be based on a microcomputer provided with a user interface **161** and a program memory **162**. The program memory can be called by explanatory icons displayed on the user interface, which can comprise a touch screen. When the user selects an order icon, to order a type of refreshment or meal, the corresponding program in the program memory **162** is loaded into the control unit **160** and executed by the latter. It is thus possible to execute all of the operations described below. The control unit **160** is provided with means **163** for reading sensors which include:

- a sensor **164** of displacement of the vertical plate of the handling basket;
- a sensor **165** of the horizontal displacement of the basket constituted by the vertical plate and the two side flanks;
- a sensor **166** of displacement of the side flanks on the vertical plate together;
- a sensor **167** of the relative displacement of the right flank with respect to the left flank;
- a sensor **168** of the relative displacement of the left flank with respect to the right flank;
- a sensor **169** of displacement of the trolley between the two side flanks during the insertion of the trolley into and/or extraction of the trolley from one of the compartments;
- a sensor **170** for detection of the approach of the predetermined compartment by the handling basket; and
- a sensor **171** of the position of the doors or openings in the flexible wall or walls on the roller mechanism of FIGS. **16** and **17**.

Similarly, the control unit **160** comprises a means of control **172** of the control circuits of various motors of the handling device which have been previously described and which are principally:

- the first and second motors of the vertical displacement means **5** and **6** (FIG. **1**);
- the motors **7** and **8**:
- the gripping movements **13** and **14** of the two flanks **38** and **39** on the vertical plate **2**;
- the movement **12** of displacement of the side flanks along the vertical plate together;
- the motors **15** on the flanks **38** and **39** for the transfer of the trolley through a predetermined compartment of the storage cabinet;
- the motors **173** for mobilization of the stops **102**, **103** supporting the base of the trolley in the basket; and
- the motors **174** of the pusher extractor **110-112** and of the locking key **121**, **122**.

The invention claimed is:

1. An automated storage cabinet for at least one trolley in a supporting structure, the automated storage cabinet comprising:

- at least two levels of compartments each intended for storing one trolley;
- a waiting area arranged on a floor of the supporting structure and adjacent to openings of the trolley storage compartments of the automated storage cabinet;
- a predetermined compartment at a predetermined level of the automated storage cabinet; and

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- a device for automatically handling a single trolley between the waiting area and the predetermined compartment,
 the device for automatically handling the single trolley comprising a handling basket, the handling basket comprising:
 a vertical plate perpendicular to the waiting area, vertically movable between a floor of the waiting area and any one of the levels of the automated storage cabinet; and
 two side flanks, connected to the vertical plate and configured to support, on either side, two opposite sides of the trolley in the waiting area and to transfer the supported trolley through an opening of the predetermined compartment, the vertical plate bearing at least one motor for producing a relative lateral displacement of the two side flanks;
 wherein the device for automatically handling the single trolley is configured to carry out insertion of the trolley into the predetermined compartment or extraction of the trolley out of the predetermined compartment;
 wherein the two side flanks comprise at least one motor configured to allow transfer of the trolley between a position situated between the side flanks and the predetermined compartment or vice versa, the at least one motor being configured to be actuated under control of a control unit cooperating with sensors for displacement of moving parts and for selecting a predetermined compartment; and
 wherein the automated storage cabinet further comprises a projector, controlled by the control unit, configured to project onto an image of a mark for alignment of a trolley on the floor in the waiting area, such that the alignment of the trolley facilitates positioning of the handling basket around the trolley.
2. The automated cabinet according to claim 1, wherein the vertical plate is mounted on at least one motor configured to confer a vertical movement upon the vertical plate.
3. The automated cabinet according to claim 2, wherein the at least one vertical movement motor of the vertical plate is duplicated on each side of the vertical plate in such a way that a control unit connected to horizontality sensors of the trolley controls horizontality.
4. The automated cabinet according to claim 2, further comprising at least one roller mechanism for a flexible wall rolled up on either side of at least one level of the compartments of the cabinet.
5. The automated cabinet according to claim 1, wherein the two side flanks comprise a plurality of removable stops for supporting, on either side, two opposite sides of a trolley, each of the removable stops being driven by a motor and being mobilized by the control unit in order to come into position under a base of the trolley during a greater part of the transfer of the trolley between the waiting area and the predetermined compartment.
6. The automated cabinet according to claim 1, wherein the two side flanks comprise a device for pushing or extracting the trolley through the opening of the predetermined compartment.
7. The automated cabinet according to claim 1, wherein the two side flanks comprise edges configured to fit parts of

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opposite walls of the predetermined compartment, each edge being configured to engage with a suitable profile of the part of the wall opposite the predetermined compartment.

8. The automated cabinet according to claim 1, further comprising at least one stiffening rod comprising a tube with a rectangular cross-section, connected to a side wall of the cabinet by bearings, and anchored to the floor and to a ceiling of the supporting structure of the cabinet so as to stiffen the structure.

9. An assembly comprising a floor of a supporting structure of a cabinet and an automated cabinet according to claim 1.

10. An aircraft comprising at least one automated storage cabinet for trolleys, according to claim 1.

11. An automated storage cabinet for at least one trolley in a supporting structure, the automated storage cabinet comprising:

at least two levels of compartments, each intended for storing one trolley;

a predetermined compartment at a predetermined level of the automated storage cabinet; and

a device for automatically handling a single trolley between a waiting area and the predetermined compartment,

the device for automatically handling the single trolley comprising a handling basket, the handling basket comprising:

a vertical plate perpendicular to the waiting area, vertically movable between a floor of the waiting area and any one of the levels of the automated storage cabinet; and

two side flanks, connected to the vertical plate and configured to support, on either side, two opposite sides of the trolley in the waiting area and to transfer the supported trolley through an opening of the predetermined compartment, the vertical plate bearing at least one motor for producing a relative lateral displacement of the two side flanks;

wherein the two side flanks are configured to move independently along a horizontal dimension of the vertical plate;

wherein the device for automatically handling the single trolley is configured to carry out insertion of the trolley into the predetermined compartment or extraction of the trolley out of the predetermined compartment;

wherein the two side flanks comprise at least one motor configured to allow transfer of the trolley between a position situated between the side flanks and the predetermined compartment or vice versa, the at least one motor being configured to be actuated under control of a control unit cooperating with sensors for displacement; and

wherein the automated storage cabinet further comprises a projector, controlled by the control unit, configured to project onto an image of a mark for alignment of a trolley on the floor in the waiting area, such that the alignment of the trolley facilitates positioning of the handling basket around the trolley.

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